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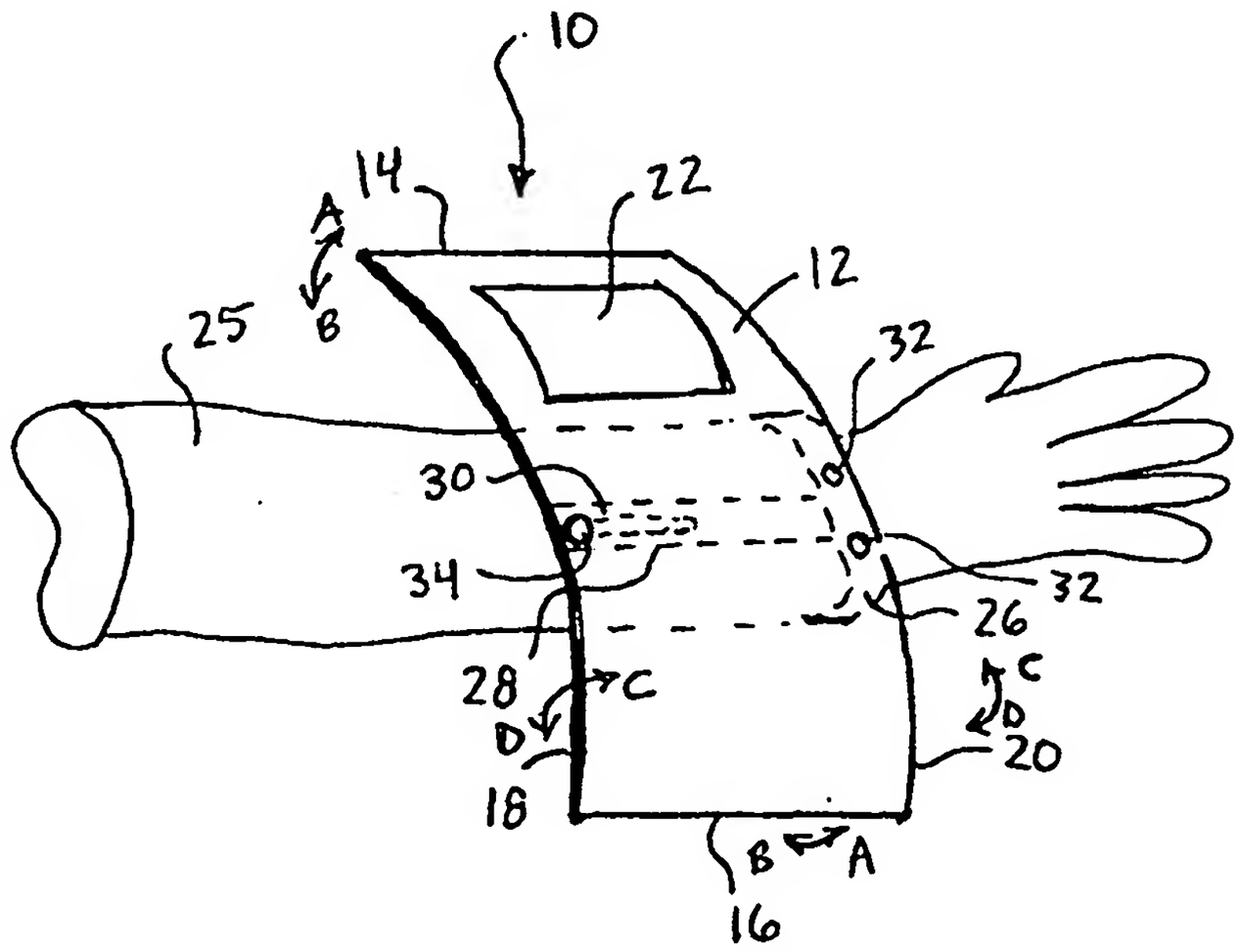

(57) Abstract

A user interface device for computing provides an interface display screen having both flexible and rigid structural characteristics as well as variable sizing and shaping features. These features provide large–scale visibility and ease of use with small form factor portability and comfort. The device is particularly suited to flexible, wearable and/or carryable computing environments, although it can be readily deployed in non–wearable and non–carryable computing environments.

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FLEX-TO-FIXED USER INTERFACE DEVICES AND METHODS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to interface devices for computer systems, for example personal computer systems designed to be worn by a human user, and more particularly, to visual display devices having comfortably wearable form factors and superior input/output capabilities.

2. Description of Related Art

Wearable computing devices of many different types are being used in a host of commercial, industrial and consumer environments. The best wearable computers are lightweight and flexible, demonstrating superior ergonomics and allowing use during all normal activities. According to one example, flexible circuitry or equivalent flexible transmission devices join physically independent computer modules, allowing comfortable distribution of the computer about the body to accommodate a wide variety of body morphologies. Standard-interconnect input/output devices allow easy user upgrades and modular replacements. Spread-spectrum wireless Local Area Networks allow interaction with other users and/or with a host computer system. Flexible wearable computing devices are comfortable, easy-to-use, convenient and powerful alternatives to the brick-like machines that until recently have been the only choice in the marketplace.

Commonly assigned U.S. Patents Nos. 5,285,398, 5,491,651, 5,581,492, and 5,798,907 to Janik, and commonly assigned U.S. Patents Nos. 5,555,490 and 5,572,401 to Carroll, all of which are incorporated by reference herein, disclose a number of extremely advantageous designs that are expected to dominate over previous, brick-like wearable computers.

Typical portable displays are rigid and can be cumbersome to carry and/or uncomfortable to wear. Displays which are small enough to be pocketable have thickness and/or rigidity factors that make accommodating them somewhat awkward over long periods of time. Further, even "sheet" computer prototypes, e.g., Sharp Electronics' conceptual system-on-panel (SOP) computer (having a form factor only millimeters thick),

are generally rigid and thus present comfort problems. Head-mounted displays also are known for use in a variety of situations, but typically are bulky, heavy, hot, otherwise uncomfortable and aesthetically displeasing.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a display that has both flexible and rigid structural characteristics, and/or variable sizing and shaping, producing significant advantages over prior art body-wearable and carryable display systems. Embodiments of the invention combine the advantages of large-form-factor displays, e.g., visibility and ease-of-use, with the comfort and portability of far-smaller displays.

In one example, a display of the present invention is removably worn about a body part in a first wrapped, generally semi-rigid or fixed configuration. The display is preferably a flexible sheet having at least a portion acting as a display and/or an interactive visual interface. When desired, the user flexibly unwraps the display from the body part and then flexibly manipulates the display into a second semi-rigid configuration that is removably secured relative to the same body part or another body part. Of course, this conformable display exhibits the same dual flexible/semi-rigid capability when deployed apart from a user's body, for example, on a desktop. In another example, a display of the present invention includes multiple sheet sections that are movably connected together to permit rotation, folding, and/or sliding of the sheet sections relative to each other. The display and/or interactive visual interface is viewable on at least one of the sheet sections, but is optimally viewable on a portion of all or some of the sheet sections. The sheet sections are moved relative to one another to vary the size and shape of the display. Of course, the multiple sheet sections are wearable to make viewing easier.

With these dual flexible/semi-rigid characteristics and variable sizing/shaping features, which can be combined or employed individually, a display of the present invention produces a highly portable, comfortable display that is easily wearable and/or carryable. Taken together, these features yield a display that selectively conforms to its environment in a chameleon-like fashion.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be described with reference to the figures, in which like reference numerals denote like elements and in which:

Figure 1 is a perspective view of an interactive display device in a semi-rigid configuration, according to an embodiment of the invention;

Figure 2 is a perspective view of the device of Figure 1 in the semi-rigid configuration as worn on a user's arm, according to an embodiment of the invention;

Figure 3 is a perspective view of the device of Figure 1 in a generally flexible configuration, according to an embodiment of the invention;

Figure 4 is a perspective view of the device of Figure 1 in a semi-rigid convex configuration, according to an embodiment of the invention;

Figure 5 is a perspective view of the device of Figure 1 in a generally semi-rigid concave configuration, according to an embodiment of the invention;

Figure 6 is a perspective view of the device of Figure 1 in a generally tubular configuration when standing on end, according to an embodiment of the invention;

Figure 7 is a cross-sectional view of a display device in a generally semi-rigid configuration, according to an embodiment of the invention;

Figure 8 is a cross-sectional view of a display device in a generally semi-rigid configuration including additional support features, according to an embodiment of the invention;

Figure 9 is a perspective view of the device of Figure 8, according to an embodiment of the invention;

Figure 10 is a plan view of a multiple screen display device with square-shaped sections in a compacted configuration, according to an embodiment of the invention;

Figure 11 is a top plan view of the device of Figure 10 in an expanded configuration, according to an embodiment of the invention;

Figure 12 is a top plan view of the device of Figure 10 in a partially expanded configuration, according to an embodiment of the invention;

Figure 13 is a top plan view of a multiple screen display device with pie-shaped sections in a compacted configuration, according to an embodiment of the invention;

Figure 14 is a top plan view of the device of Figure 13 in a partially expanded configuration, according to an embodiment of the invention;

Figure 15 is a schematic view of the device of Figure 13-14 in a fully expanded configuration as worn about a user's neck , according to an embodiment of the invention;

Figure 16 is a schematic view of a multiple screen display device as worn about a user's neck, according to an embodiment of the invention;

Figure 17 is a perspective view of a foldable multiple screen display device, according to an embodiment of the invention;

Figure 18 is a perspective view of a multiple screen display device in the configuration of an umbrella, according to an embodiment of the invention;

Figure 19 is sectional view of a wearable PC support component for use with a display device, according to an embodiment of the invention;

Figure 20 is a perspective view of the device of Figure 1 with additional communication features, according to an embodiment of the invention;

Figure 21 is a sectional view of a display device with an internal support structure, according to an embodiment of the invention; and

Figure 22 is a sectional view of a display device with a sheet-like internal support structure, according to an embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Embodiments of the invention have wide application to a number of different computing technologies and environments. Flexible, wearable computers are gaining rapid acceptance in the marketplace in different computing environments, including military, maintenance, law enforcement, medical and other environments. Further, highly visible and portable display devices are important in virtually all computing environments using graphic or text input/output, not just in wearable-computing environments. Accordingly, although particular embodiments of the invention will be discussed with respect to wearable computers and in particular flexible, wearable computers, the invention is not necessarily limited to those embodiments. Rather, embodiments can be carried and/or used in a desktop environment, among other possibilities.

Flex-to-fixed interface device 10 of the present invention is shown generally in Figure 1. Device 10 includes sheet 12 having first and second edges 14, 16 and third and fourth edges 18, 20. Device 20 further includes display or interface screen 22 as well as optional bracket 24.

Sheet 12 of device 10 is preferably formed of a resilient, shape-holding flexible layer. As shown, the resiliency of sheet 12 generally holds the tubular shape shown but can be "unwrapped" by flexibly moving edges 14 and 16 away from each other and pulling them back along direction A of the directional arrows. Conversely, sheet 12 can be brought into a more closed tubular position by pressing edges 14, 16 closer together along direction B of the directional arrows. To assist the shape-holding characteristics of sheet 12 to maintain a generally fixed position such as the tubular shape shown in Figure 1, fastener or bracket 24 (or other suitable fixing device) is optionally used to secure edges 14 and 16 together.

Sheet 12 generally forms a "touchscreen" type interface that allows visual display and touch-activated input, like a computer monitor. As shown in Figure 1, interface screen 22 represents the active area on sheet 12 which supports such "touchscreen"-type technologies including visual display, input/output functions, and optional key-reduction algorithms. Of course, device 10 can be turned on or off.

While interface screen 22 is shown only occupying a portion of sheet, interface screen 22 is optionally sized to cover the entire surface of sheet 12 or only a portion of sheet 12. Moreover, interface screen 22 is locatable in any desired portion of sheet 12 and is not restricted to the location shown in Figure 1. Likewise, interface screen 22 includes a variable shaping feature so that screen 22 is not restricted to the rectangular shape shown in Figure 1. The size, location, and shape of screen 22 on sheet 12 is controlled by appropriate software drivers, known or readily discernible to those skilled in the art, associated with a CPU-based computing system 23 that communicates with device 10 through wired or wireless, RF, body LAN, and other well-known communication techniques.

As shown in Figure 2, device 10 is particularly adapted to be worn about forearm 25 or another body part of a user (e.g., thigh, waist, etc.). In this arrangement, device 10 is in a "wrapped" configuration, accommodating the morphology of forearm 25 and allowing easy portability. Opposite edges 14,16 of device 10 are adjusted either to contact each other or be adjacent each other, depending on the tightness of wrap desired by the wearer. Moreover, device 10 also optionally includes a suitable fixing device such as bracket/fastener 24 to substantially fix the degree of wrap of device 10 about arm 25. In this configuration, device 10 is generally flexible in a longitudinal, wrap/unwrap

orientation (i.e., generally transverse to a longitudinal axis of forearm 25) yet generally fixed (or semi-rigid) in a lateral orientation (i.e., generally parallel to a longitudinal axis of forearm 25).

As used in this configuration, interactive screen 22 occupies only a portion of the surface of sheet 12, particularly the area shown that is readily viewable on device 10 when worn on forearm 25 of the user. However, when a larger display area, input surface, and/or additional functions are desired, or when device 10 is expected to be used for long periods of time, the user "unwraps" device 10 and manipulates it into a new configuration more suitable for these purposes. As device 10 is unwrapped from forearm 25, software-driven sizing features optionally enlarge and reduce active screen 22 of display sheet 12 automatically (or manually), depending on the degree of wrap/unwrap of device 10.

Figure 3 illustrates device 10 in an intermediate, flexible configuration just after being unwrapped from forearm 25 (Figure 2). Device 10 also exhibits the configuration of Figure 3 just prior to being wrapped about forearm 25. As shown in Figure 3, device 10 further includes band 26, lateral support 28, slot 30, and fasteners 32, 34. Band 26 is secured to sheet 12 with fasteners 32 and removably secures device 10 about arm 25, or other preferred body part. Lateral support 28 extends from band 26 to further support sheet 12 along forearm 25. Fastener 34 extends between sheet 12 and support 28, and is slidably movable within slot 30 to permit edge 18 of sheet 12 to move laterally relative to lateral support 28 and forearm 25. Of course, other schemes for removably securing device 10 about arm 25 may be used.

In the configuration shown in Figure 3, device 10 is flexible in at least two directions: in a longitudinal, wrap/unwrap direction (shown by directional arrows A and B) and in a lateral, flex/fixed direction (shown by directional arrows C and D) as will be further described. Accordingly, in any given configuration device 10 can be flexible in one orientation yet generally fixed (or semi-rigid) in another orientation. For example, as shown in Figures 1-2, device 10 is flexible in the longitudinal, unwrap/wrap direction yet generally fixed (or semi-rigid) in the lateral direction. In contrast, when in the configuration shown in Figure 3, device 10 is generally flexible in both the longitudinal and transverse directions. This dual flexibility may make certain input/output operations, especially touch-input operations, device 10 more difficult. However, device 10 still provides input and output functions and displays text and/or graphics as it is wrapped or

unwrapped. Finally, as will be shown next in Figure 4, device 10 is generally fixed (or semi-rigid) in the longitudinal direction (A-B) yet generally flexible in the lateral direction (unless or until secured with a suitable fixing device).

To produce maximum input/output functionality and/or a larger display screen surface, device 10 is further manipulated from the intermediate, dual flexibility configuration of Figure 3, to a generally fixed configuration as shown in Figure 4, in which device 10 is generally fixed (or semi-rigid in the longitudinal orientation, and generally flexible in the transverse orientation.. To do so, the user curves device 10 in a lateral direction as shown in Figure 4, forming a lateral, downward-facing arc 33 and thereby imparting a convex configuration to interactive screen 22 of device 10. With arc 33, sheet 12 has a radius of curvature 36. Arc 33 imparts substantial rigidity to device 10 along the longitudinal orientation to provide a far more stable structure for touchscreen functions including input/output operations. In addition to, or in place of the slot 30 and fastener 34 combination shown in Figures 3 and 4, mechanical stops, bands, pins, hook-and-loop fasteners, and other equivalent devices can be used to support device 10 in the arc configuration.

As shown in Figure 5, as an alternative to downward arc 33 and the associated convex configuration of device 10, sheet 12 is flexed into an upward facing arc 35, imparting a concave configuration for interactive screen 22 and sheet 12 of device 10. This upward facing arc still gives device 10 a substantially rigid configuration while permitting a different arrangement relative to forearm 25.

According to another embodiment shown in Figure 6, interactive device 40 includes sheet 42 with ends 42, 44, side 46, and interactive screen 48. Device 40 carries substantially the same features as device 10, previously discussed in conjunction with Figures 1-5. However, as shown in Figure 6, device 40 is formed into a permanent tubular shape or is placed in a tubular shape by forcing together edges 14,16 of device 10. Such a tubular display can be mounted in an appropriate recess, or can stand by itself, kiosk-style on desk 41 or other support.

Accordingly, for the first time, embodiments of the invention combine, in the same interface device, (1) ready portability and small form factor in a flexible, wearable configuration with (2) an option for a larger, substantially rigid configuration. Broadly speaking, by positioning the edges of device 10 in one or more locations, and more

specifically substantially fixing or holding the edges of the sheet-type component(s) that form(s) device 10 with appropriate mechanical or other devices, a form or format is achieved that changes a flexible interface device to a fixed (or semi-rigid) interface device. Of course, this form also permits changes from a fixed interface device to a flexible interface device. Finally, this form permits changes between two (or more) different fixed interface configurations by flexible manipulation of the interface device.

Embodiments of the invention include various software components to optimize interface device 10 in its different configurations. In addition to the sizing features described above, a "touchmatch" feature automatically adjusts for touchscreen-layer alignment differences that occur as device 10 is flexed into its different configurations. More specifically, as shown in Figure 7, touchscreen interface device 50 of the present invention (having the substantially the same features as device 10 in Figures 1-5) includes at least two contact-sensitive layers such as outer layer 52 and inner layer 54. Outer layer 52 is provided for contact with a finger or other pointing device and usually includes visible indicia 56 in the form of keys or icons for targeting the finger/pointer contact. Inner layer 54 underlies outer layer 52, providing a set of contact elements 58 associated with visual indicia 56, and is arranged in more direct association with the appropriate processing electronics. When such touchscreen devices are in a planar configuration (as is the case with most if not all typical touchscreens), visible indicia 56 of outer layer 52 generally are in direct alignment with appropriate contact elements 58 in underlying layer 54.

As device 10 is curved, however, inner layer 54 and outer layer 52 slide relative to each other and the direct alignment between them is altered, if not lost. Upon device 50 being curved either laterally or longitudinally, as described above, a virtual center of curvature is formed. Figure 4, for example, illustrates virtual center of curvature 37 as device 10 is curved laterally to impart rigidity. In the longitudinally-curved configuration of Figure 2, the center of curvature (not shown) is within forearm 23. In either case, outer layer 52 of the appropriate touchscreen is at a greater radial distance from the center of curvature than inner layer 54, causing a misalignment between visible indicia 56 of outer layer 52 and contact elements 58 of underlying layer 54. Software features readily discernable to one of ordinary skill in the art can be implemented to automatically compensate for this misalignment.

Although misalignment compensation or enhancement features according to the invention have been described in relation to touchscreen embodiments, the same principles apply and are contemplated for use with other layered elements in interactive device 10, e.g., display elements.

To minimize and better accommodate the misalignment in the more heavily used areas of interactive screen 22 of device 10 (Figures 1-4), a "butterfly" configuration is provided, as shown in Figures 8-9. Device 60, having substantially the same features as device 10, includes screen or other layers 62, 64 along with rib 66 and edge fastener 68. As best seen in the cross-sectional view of Figure 8, rib 66 is sandwiched between layers 62 and 64, securing layers 62 and 64 together at a relatively central location. As further shown in the perspective view of Figure 9, rib 66 extends longitudinally along device 60. Rib 66 permits sliding between layers 62 and 64 but in a more controlled and predictable fashion than in a multilayered touchscreen device lacking rib 66. Outer edges 67 of layers 62,64 are optionally connected together with one or more fasteners 68 to prevent "flapping" of layers 62, 64 relative to each other, but in a manner which optionally accommodates parallel sliding of layers 62,64 relative to each other. Fasteners 68 include rails, interconnected slide points or slide edges, among other types of such fasteners with those capabilities.

According to one embodiment of the present invention shown in Figure 10, interface device 70 comprises multiple square-shaped screen layer sections 72 (with other screen-supporting layers). Sections 72 are connected at one or more pivot point(s) 74, preferably located in corners of sections 72, and together form interactive (or passive) display 76. Sections 72 of device 70 may be slidably rotated relative to one another to increase or decrease the size of the viewing display 76, or alter its configuration. As seen in Figure 10, multiple screens or other layers 72 are compacted or stacked to minimize the profile of device 70. Alternatively, as seen in Figure 11, multiple screen sections 72 are spread out relative to each other to expand display 76. Finally, as shown in Figure 12, screens 72 are pivoted relative to each other in a partially overlapping configuration to form display 76. When compacted as in Figure 10, device 70 is highly suitable for wearability, portability, and intermittent use, while when expanded as in Figure 11, device 70 is conducive for, e.g., stationary use or for applications requiring greater definition. Each screen or other layer 72, or group of a selected number of screens/layers 72, are

supplied with its own device driver. The device drivers can be written to vary the amount, shape, and/or number of screen(s) 72 used for a display 76, depending upon the particular use or shape of device 70.

Similarly, device 80 of the present invention shown in Figures 13-14 includes substantially the same features as device 70 of Figures 10-12, except includes pie-shaped screen sections 82 instead of square/rectangular shaped screen sections 72. Pie-shaped screen sections 82 are secured together with pivoting mechanism 84 and individually or collectively form display 86. As with device 70, pie-shaped screen sections 82 are viewable in their entirety (side-by-side), partially as seen in Figure 14, or in a stacked configuration as seen in Figure 13 in which only the top most pie-shaped screen section 82 is viewable with the remaining screen sections 82 underneath.

These embodiments (Figures 10-14) can be employed by any number of screens or other layers 72, 82, and in multiple shapes (e.g., mixing of pie and square shapes, or with other shapes) as determined by the user. The device drivers select the screen(s) 72, 82 that are used for display, input or other function, based on that portion of each screen that is exposed to a user (i.e., that portion of a screen not hidden behind another, overlapping screen). The screens or screen portions 72, 82 are preferably selected based on the configuration of device 10 and/or the activity of the user.

Device 10, as well as devices 70, 80, can be configured for placement about a user's wrist, waistband or hip, neck, thigh, etc., or any other suitable location. In one example, as shown in Figure 15, device 80 is placed about user's neck 90 using band 88, with pie-shaped screen sections (or other layers) 82 arranged side-by-side to produce a larger, integrated pie-shaped display 86. This large, pie-shaped configuration is especially well suited for hanging about the neck since it minimizes the area of display 86 that is nearest the neck and hardest to see, and maximizes the area of display 86 that is furthest from the neck and easiest to see. Of course, pie-shaped sections 82 can be arranged in a stacked configuration (with only the top most section available for viewing, as in Figure 12) for storage or other space-minimizing purposes.

Similarly, an interactive device of the present invention can be worn about the body in other configurations such that shown in Figure 16 in which interactive device 100 includes screen sections 102 arranged in a side-by-side configuration with substantially parallel adjacent edges to collectively form display 104. Band 106 secures device 100

about user's neck 108 or other body part. As shown in Figure 16, screen sections 102 form a horseshoe-shaped arrangement about neck 108. As before, necessary software screen drivers coordinate touchscreen, display, and input/output functions on screen section(s) 102.

In another embodiment, interactive device 120, of the present invention, is arranged in a fanfold or foldout configuration. Device 120 includes multiple screen sections 122, which are arranged side-by-side and interconnected at edges 124. Device 120 further includes first side 126 and second side 128. Screen sections 122 collectively form display 130 viewable on first side 126 and/or back side 128.

According to another embodiment shown in Figure 18, interactive device 140 of the present invention incorporates an interactive device in the form of an umbrella, or similar configuration. Device 140 includes multiple pie-shaped screen sections 142, secured about center or pivot 144 to collectively form canopy-shaped display 148. Stem 146 extends from the underside of display 148 and operatively houses the remaining necessary hardware of device 140. Stem 146 serves as a standing apparatus to enable upright placement of device 140 on a table, desk or within another suitable structure. Screen(s) or other layers 142 may spread out flat at one end of stem (as shown) or, alternatively, may be curved to enhance viewing. Device 140 can employ radiating or reflective sound means to create a surround-sound effect, e.g., when multiple devices are used together. The invention contemplates small-scale applications similar to those described herein, as well as large-scale applications including, for example, an advertising screen.

As flexible display devices and in particular flexible touchscreens are developed for commercial use, embodiments of the invention for the first time combine the advantages of flexibility (e.g., portability and comfort) with the advantages of rigidity (e.g., stability for touch input and easy, large-scale viewing), making such embodiments especially suitable for use in wearable-computing environments. Interactive device 10 in its various embodiments can be viewed easily by the user, and then more easily by others when in its extended and fixed configuration. Touch interface is readily accommodated, and entire images are easily viewed due to the large size of the display.

As shown in Figure 19, support components 150 for interface device(s) 10, 70, 80, etc., such as processing components and other peripherals communicating with device 10,

etc., can be worn on body 152 in, on, or under clothing using belt 153. The above-identified patents to Carroll and Janik cover examples of flexible, wearable computers that are especially advantageous for this purpose, and are expressly herein incorporated by reference. RF or other wireless communication can be used for data transmission between the wearable computer or other components on belt 153 and interface device 10 (or 70, 80, etc.), although wired communication also is contemplated.

Because interface device 10 is flexible, it can be mounted on or in association with a flexible battery with the memory contained therein. For example, devices 50, 60 shown in Figures 7–8 each include two or more layers, 52, 54 and 62, 64 respectively. One of these layers, such as layer 54 or 64, or an additional layer, can comprise a flexible battery with memory.

As shown in Figure 20, another embodiment of interactive device 10 further eases wearable use by including a two-way verbal communication system having microphone 164 and retractable ear bud or plug 166. When device 10 is mounted on a body part, such as forearm 23, as shown in Figure 2, microphone 164 of device 10 will be positioned near the user's wrist, permitting the user to speak into microphone with the user raising microphone 164 near the user's mouth as necessary (i.e., depending upon the capabilities of the microphone). When ear bud 166 is retracted from device 10 up to adjacent the user's ear, then the combined microphone/ear bud components are properly positioned to facilitate two-way verbal communication.

Embodiments of the invention, such as device 10 shown in Figure 20, optionally include CMOS camera 162, as to facilitate two-way video conferencing and communication, preferably in association with microphone 164 and retractable ear bud 166.

Finally, it is known that flexible motherboards and other flexible devices optionally incorporated in device 10 do not have an unlimited flexible lifespan. The degree of bending sharpness to which device 10 is subjected in part determines its flexible life. Therefore, as shown in Figures 21 and 22, embodiments of the invention optionally include packaging restriction elements such as cable or relatively stiff sheets disposed behind or in between the disclosed layers or motherboard. For example, Figure 21 shows interactive device 170 having screen layers (or other layers) 172, 174 with cables 176 extending therebetween. Similarly, Figure 22 shows interactive device 170 having sheet(s) 178 of a

relatively stiff material generally having different durometer value(s) than the screen layers (or other PC support layers) of device 10. These packaging restriction elements, such as cables 176 or stiff sheets 178, prevent sharp bending movements that would have caused unacceptably high bending stresses or even crimping on the operative screen layers or other layers of device 10.

While the invention has been described with reference to specific embodiments, the description is illustrative and is not to be construed as limiting the scope of the invention. Devices according to the invention can be used with not only wearable, but other types of computing devices. Wireless or wired, infrared, optical, and other communication schemes are contemplated. Flexible circuitry, ribbon or otherwise, and/or additional signal-relaying componentry can be used in all embodiments of the invention. By "signal" is meant power signals, data signals, and other electrical, optical, IR, RF, or other signals providing transmission and/or communication. Various other modifications and changes may occur to those skilled in the art without departing from the spirit and scope of the invention.

CLAIMS

1. A user interface device for computing comprising:

a sheet conformable between at least one generally flexible configuration and at least one generally fixed configuration; and

a visual interface disposed on the sheet for communication with associated computing elements.

2. The interface device of claim 1 wherein the visual interface comprises a display screen.

3. The interface device of claim 1 wherein the visual interface comprises an input/output device.

4. The interface device of claim 3 wherein the visual interface is a touchscreen-type input/output device.

5. The interface device of claim 1 wherein the sheet further comprises a plurality of layers.

6. The interface device of claim 5 wherein each layer includes at least a portion of the visual interface and the layers cooperate together to form the visual interface having variable sizing, shape and location on the sheet.

7. The interface device of claim 5 wherein the layers are slidably connected together.

8. The interface device of claim 5 wherein the layers are pivotally connected together at a vertex of the layers.

9. The interface device of claim 5 wherein each layer comprises a square shape or a pie shape.

10. The interface device of claim 5 wherein at least one of the layers is a support sheet and is made of material that is stiffer than the display sheet.

11. The interface device of claim 1 and further comprising:

a mechanism for varying the size, shape, and location of the visual interface on the sheet.

12. The interface device of claim 11 wherein the sheet further comprises multiple layers and the mechanism further comprises a fastener pivotally connecting the layers together at a vertex to permit sliding movement of the layers relative to one another, thereby permitting modification of the size, shape, and location of the visual interface surface.

13. The interface device of claim 1 wherein the sheet is conformable into a generally arcuate shape.

14. The interface device of claim 13 wherein the arcuate shape produces a downward facing convex configuration.

15. The interface device of claim 13 wherein the arcuate shape produces an upward facing concave configuration.

16. The interface device of claim 1 wherein the sheet is conformable into a generally tubular shape.

17. The interface device of claim 16 wherein the sheet includes a pair of opposed edges extending generally parallel to a longitudinal axis of the generally tubular shape.

18. The interface device of claim 17 and further comprising at least one fastener removably connected to the sheet between the opposed edges for constraining movement of the opposed edges relative to one another.

19. The interface device of claim 1 wherein the sheet is conformable from a generally semi-rigid, arcuate shape having a first longitudinal axis to a second generally semi rigid, arcuate shape having a second longitudinal axis transverse to the first longitudinal axis.

20. The interface device of claim 1 wherein the sheet is conformable from a generally flexible, arcuate shape in a first transverse orientation to a semi rigid, arcuate shape in a second longitudinal orientation transverse to the first orientation.

21. The interface device of claim 1 wherein the sheet comprises at least two layers including an outer user-contact layer and an inner layer, wherein the outer layer overlays the inner layer.

22. The interface device of claim 21 wherein the outer user-contact layer and the inner layer are connected at a central location to minimize sliding of the outer and inner layers relative to one another.

23. The interface device of claim 22 and further comprising a fastener extending between the edges of the outer layer and the inner layer to prevent flapping of the outer and inner layers relative to one another.

24. The interface device of claim 1 and further comprising a band removably securable relative to a user's body part wherein the band is connected to a first side edge of the sheet for securing the sheet to the user's body part.

25. The interface device of claim 24 wherein the band further includes a lateral support extending transversely from the band and connected to a second side edge of the sheet for further securing the sheet relative to the user's body part.

26. The interface device of claim 25 wherein the second side edge of the sheet is selectively slidably movable relative to the lateral support to permit lateral flexing of the sheet.

27. The interface device of claim 1 wherein the sheet has a generally circular shape with multiple pie-shaped sections and the device further comprises a stem extending from the sheet for supporting the sheet, and wherein the sheet is conformable between a flat configuration and a curved configuration.

28. The interface device of claim 1 wherein the sheet includes a plurality of square-shaped sections secured together in an edge-to-edge configuration to permit folding of the square shape sections relative to one another.

29. The interface device of claim 1 and further comprising a CMOS-type camera disposed on the sheet for video conferencing capabilities.

30. The interface device of claim 1 and further comprising at least one packaging restriction element disposed adjacent the sheet for preventing sharp bending of the sheet.

31. The interface device of claim 30 wherein the packaging restriction element is at least one cable or at least one support sheet made of a material that is relatively stiffer than the sheet.

32. A method of visual interfacing for wearable computing comprising:

wearing a flexible sheet in a first generally semi-rigid configuration in association with a body part;

displaying a visual interface on at least a portion of the sheet; and

flexibly manipulating the sheet from the first configuration into a second generally semi-rigid configuration.

33. The method of claim 32 and further comprising, prior to the step of flexibly manipulating, substantially removing the sheet from the body part.

34. The method of claim 32 wherein the wearing step further comprises shaping the sheet into a first arcuate shape having a first longitudinal axis and wrapping the sheet in its

first arcuate shape about a body part of the user so that the first longitudinal axis is generally parallel to a longitudinal axis of the body part, and wherein the manipulating step further comprises substantially unwrapping the sheet from the user's body part and shaping the sheet from the first configuration into a second generally arcuate shape having a second longitudinal axis that is generally perpendicular to the first longitudinal axis.

35. The method of claim 32 wherein the wearing step further comprises removably securing the sheet to the body part with a body fastener.

36. The method of claim 35 wherein the securing step involves using a strap or collar as the body fastener.

37. The method of claim 32 and further comprising removing the sheet from the body part and shaping the sheet into a generally tubular configuration for placement in a non-body location.

38. The method of claim 32 and further comprising constructing the sheet from multiple contact-sensitive layers including an outer direct-touch layer and an inner layer for connecting to associated processing electronics and further comprising communicatively associating a set of touchpoints of the outer layer with a corresponding set of contact activation points of the inner layer.

39. The method of claim 32 and maintaining alignment of an outer layer and an inner layer of the sheet during bending of the sheet.

40. The method of claim 39 wherein the maintaining step further comprises securing the outer layer to the inner layer at a generally central location of the sheet.

41. The method of claim 39 wherein the maintaining step further comprises securing the outer layer to the inner layer at the edges of the sheet.

42. The method of claim 32 wherein the wearing step further comprises wearing the sheet about the neck of a user.

43. The method of claim 42 wherein the sheet further comprises multiple sheets arranged edge-to-edge and arranging the sheets in a horse-shoe-like pattern.

44. The method of claim 32 wherein the sheet comprises multiple layers and each layer has a pie-shaped section.

45. The method of claim 32 and further comprising:

compensating for a misalignment of an outer layer and an inner layer of the sheet with software to maintain operative coupled communication between the touchpoints of the outer layer and the contact activation points of the inner layer.

46. A method of computing comprising:

wearing an interactive display sheet in a first generally flexible, generally tubular configuration about a body limb, a longitudinal axis of the tubular configuration being generally parallel to a longitudinal axis of the body limb; and

bending the sheet from the first tubular configuration into second generally semi-rigid, arcuate shell configuration, a longitudinal axis of the second arcuate configuration being perpendicular to the longitudinal axis of the tubular configuration.

47. The method of claim 46 wherein the bending step further comprises aligning the longitudinal axis of the second arcuate configuration to be generally perpendicular to the longitudinal axis of the body limb.

48. The method of claim 47 wherein the wearing step further comprises:

arranging a generally rectangular sheet in first configuration so that each edge of a first pair of opposite edges of the sheet form a first arcuate shape and a second pair of opposed edges each form a straightedge shape to impart flexibility to the sheet in a direction generally transverse to the longitudinal axis of the first arcuate shape.

49. The method of claim 48 wherein the bending step further comprises:

rearranging the sheet into the second generally semi-rigid, shell configuration in which the first pair of opposed edges of the sheet form a straight edge and the second pair of opposed edges form a second arcuate shape to impart rigidity to the sheet in a direction generally transverse to the longitudinal axis of the second arcuate shape.

50. A method of visual interfacing for computing comprising:

displaying a visual interface on at least a portion of a sheet in a first generally flexible, generally tubular configuration; and

flexibly manipulating the sheet from the first configuration into a second, generally semi-rigid, generally arcuate configuration.

51. The method of claim 51 and further comprising:

removably disposing the sheet on a viewable location to permit viewing of the visual interface.

52. The method of claim 51 wherein the removably disposing step further comprises:

wearing the sheet about a portion of a user's body.

53. A user interface device for computing comprising:

a sheet conformable between multiple flexible configurations and multiple fixed configurations; and

a visual interface disposed on the sheet for communication with associated computing elements.

54. A user interface device for computing comprising:

a plurality of sheets connected together; and

a visual interface disposed on at least a portion of the plurality of sheets for communication with associated computing elements.

55. The interface device of claim 55 wherein the plurality of sheets partially overlap each other and the visual interface is disposed on a visible portion of each sheet.

56. The interface device of claim 55 wherein the plurality of sheets are arranged edge-to-edge and the visual interface is disposed on at least a portion of each sheet.

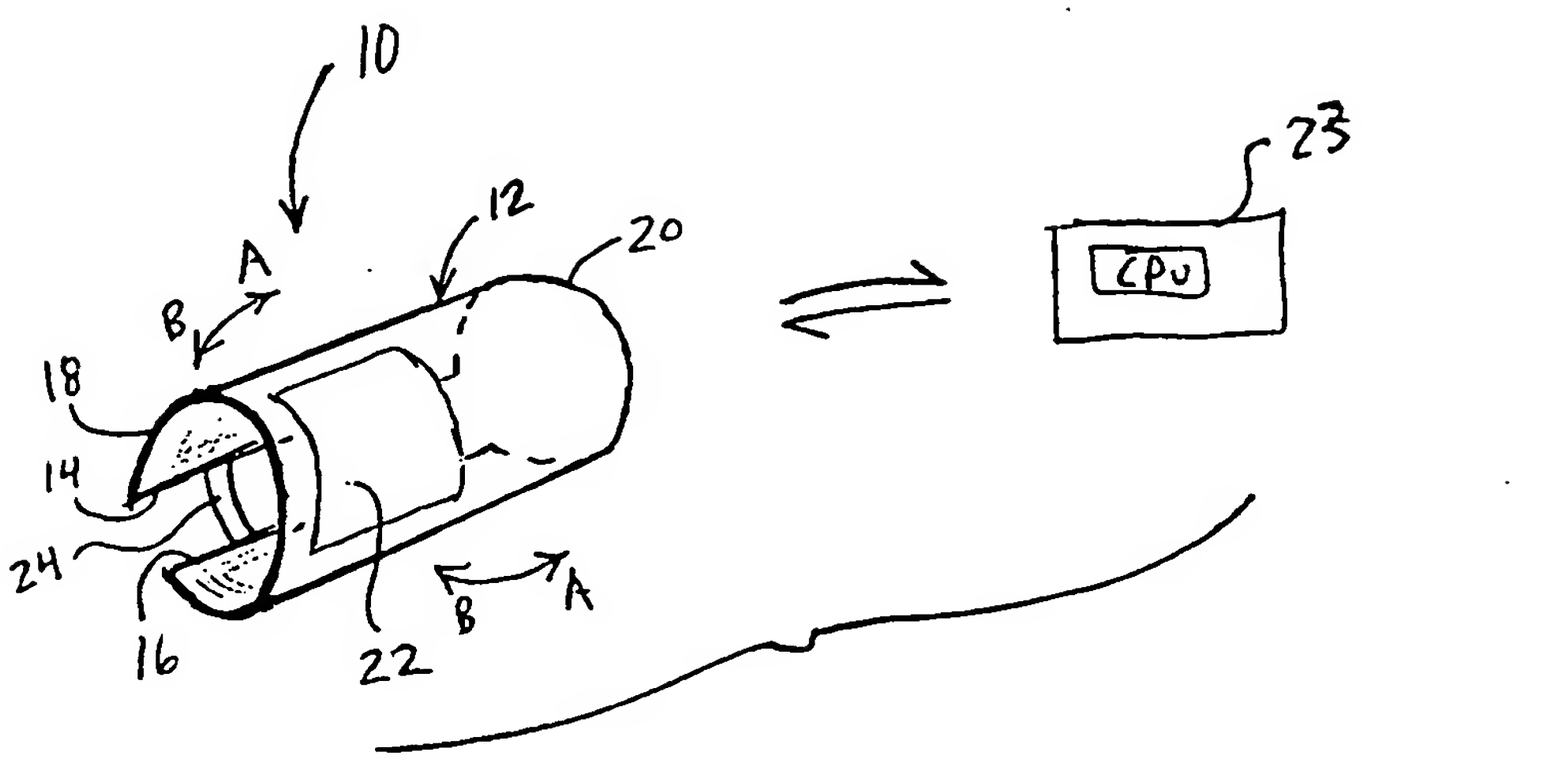

Fig. 1

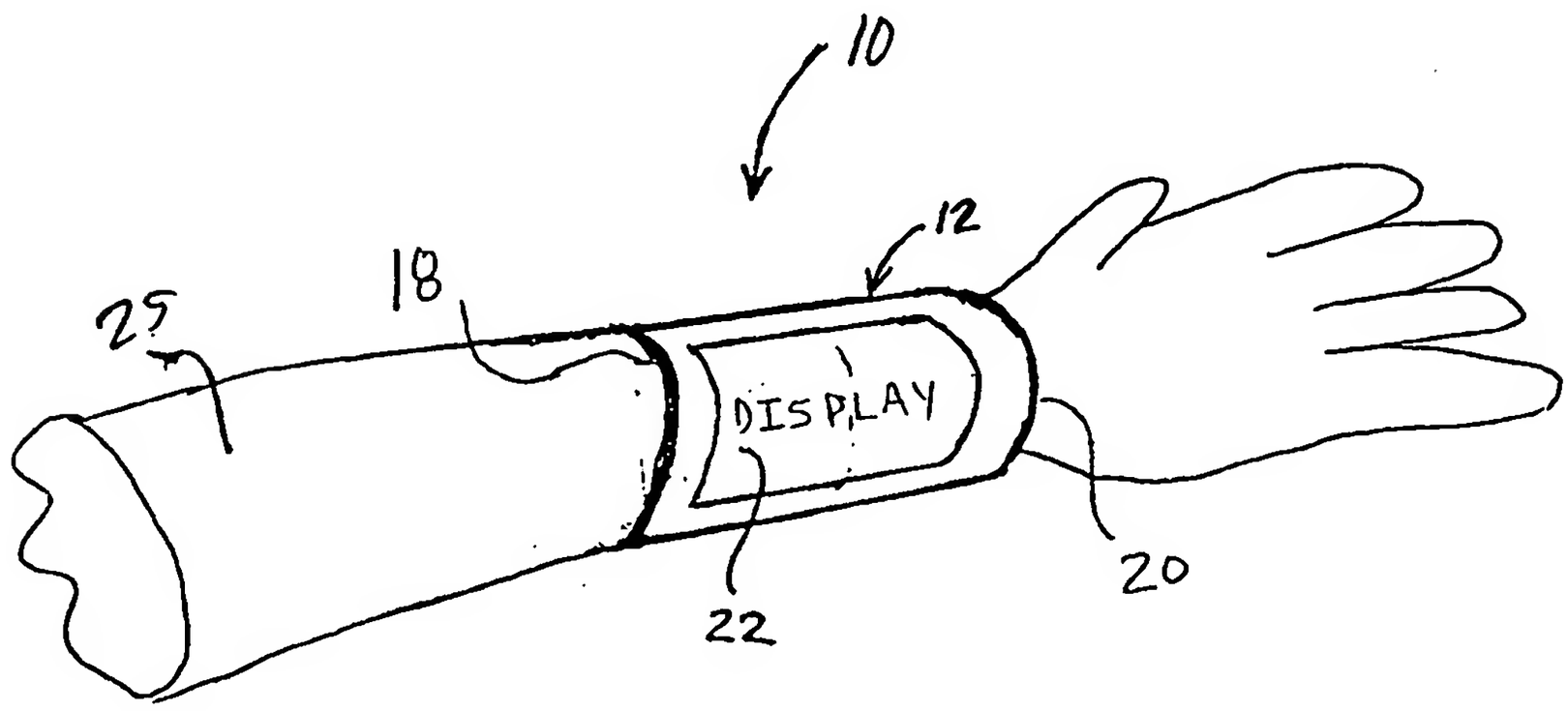

Fig. 2

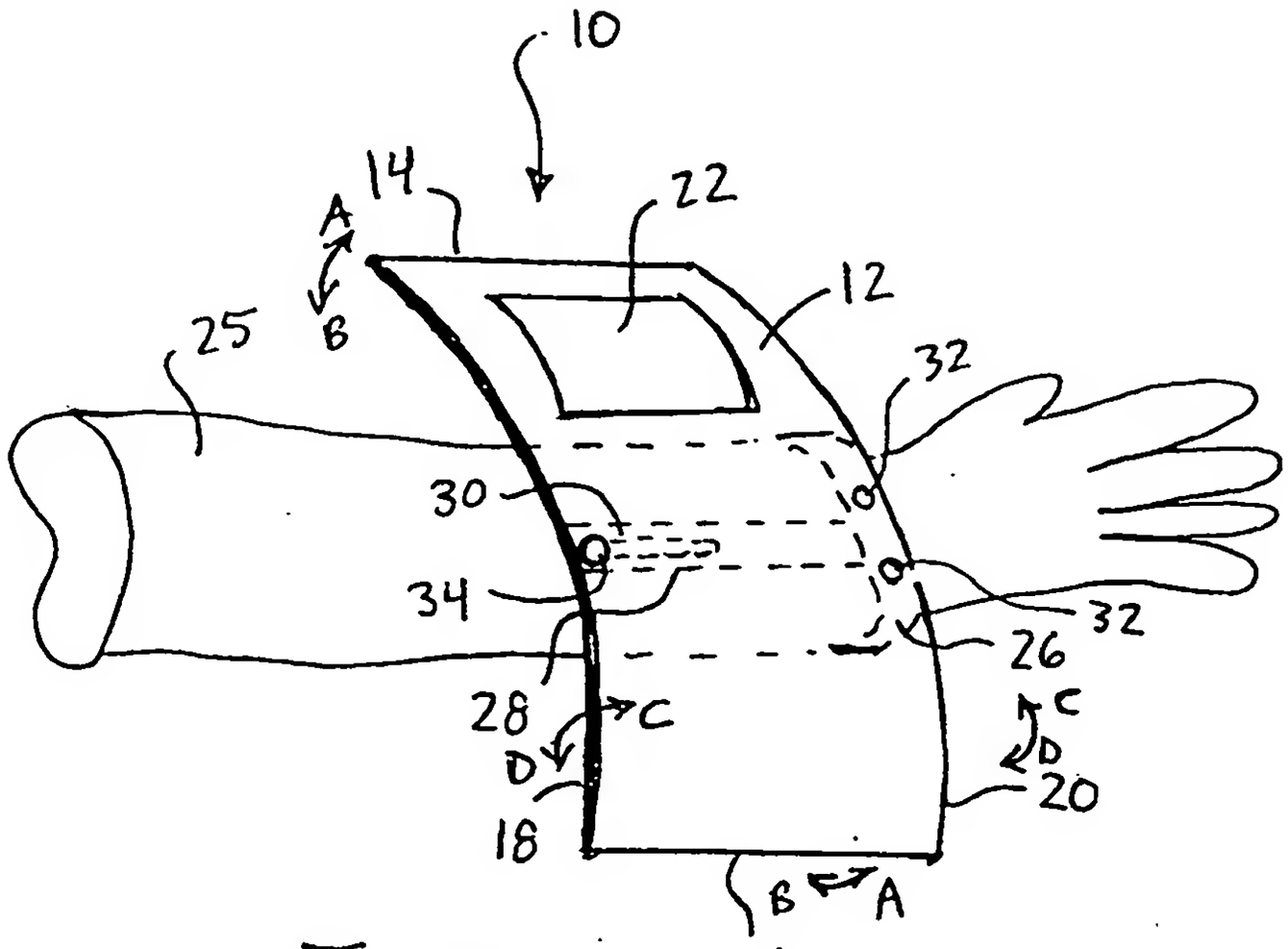
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Fig. 3

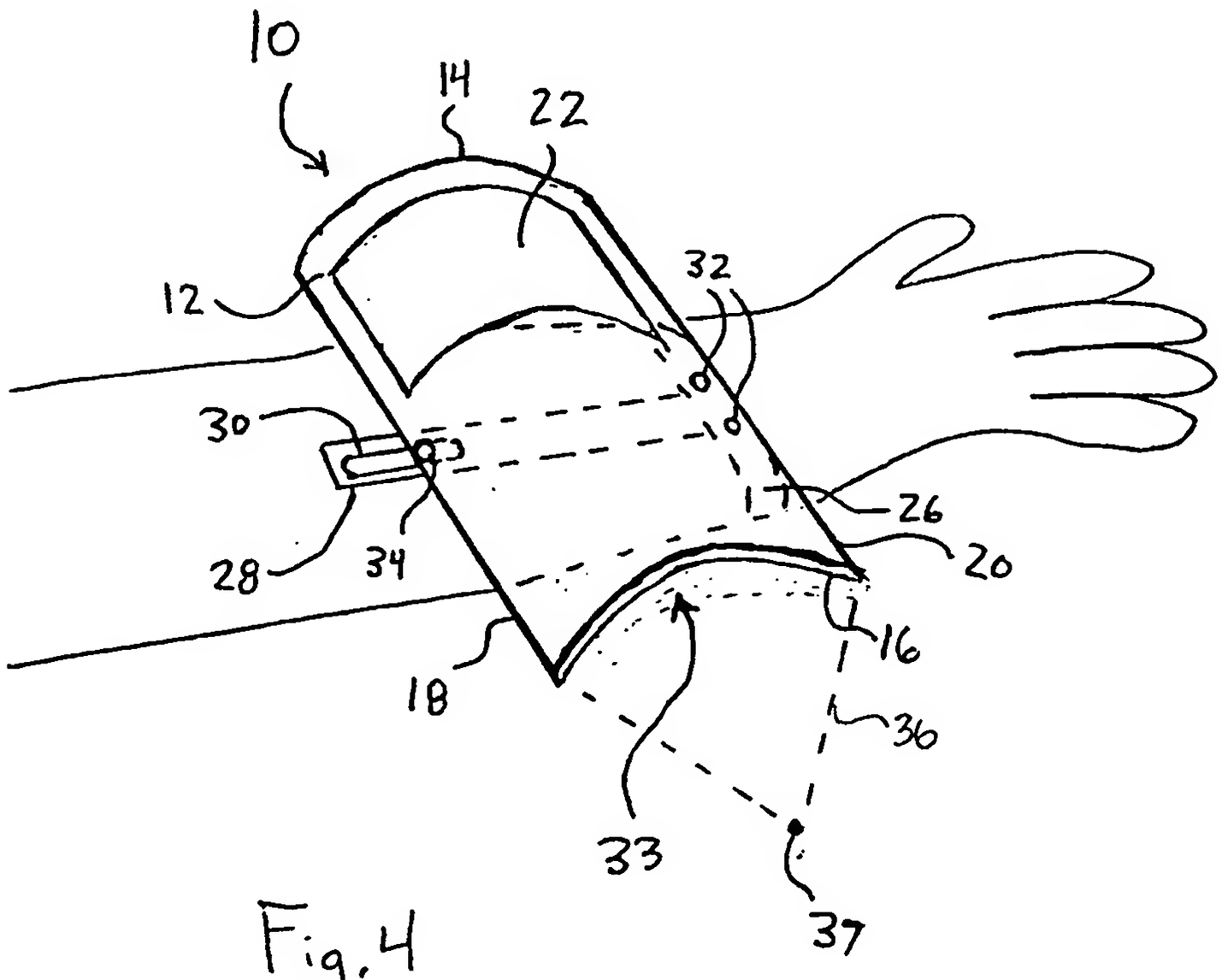
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Fig. 4

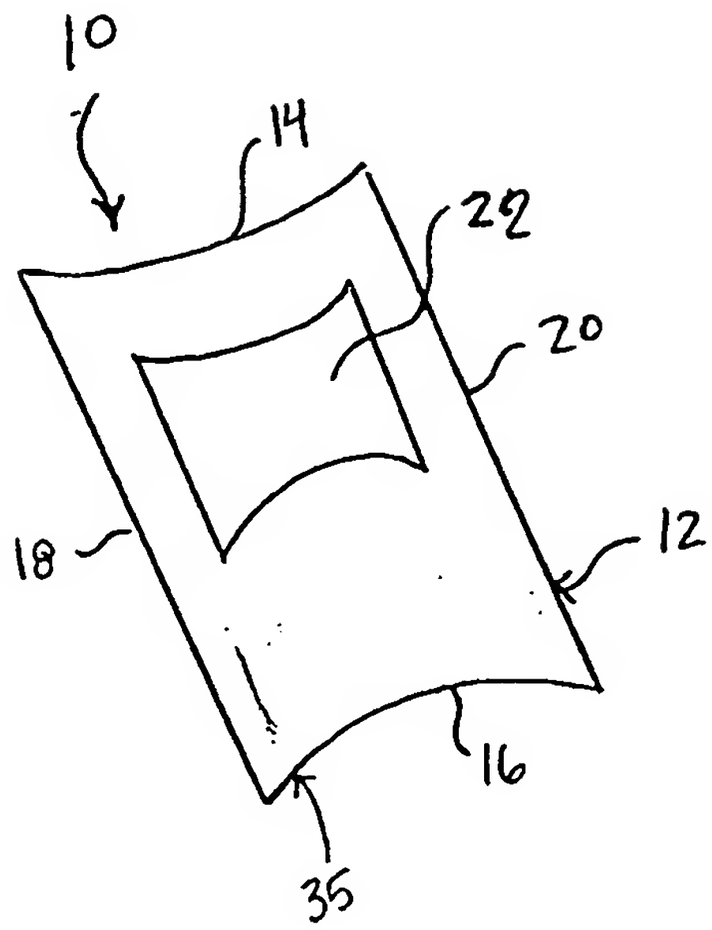

Fig. 5

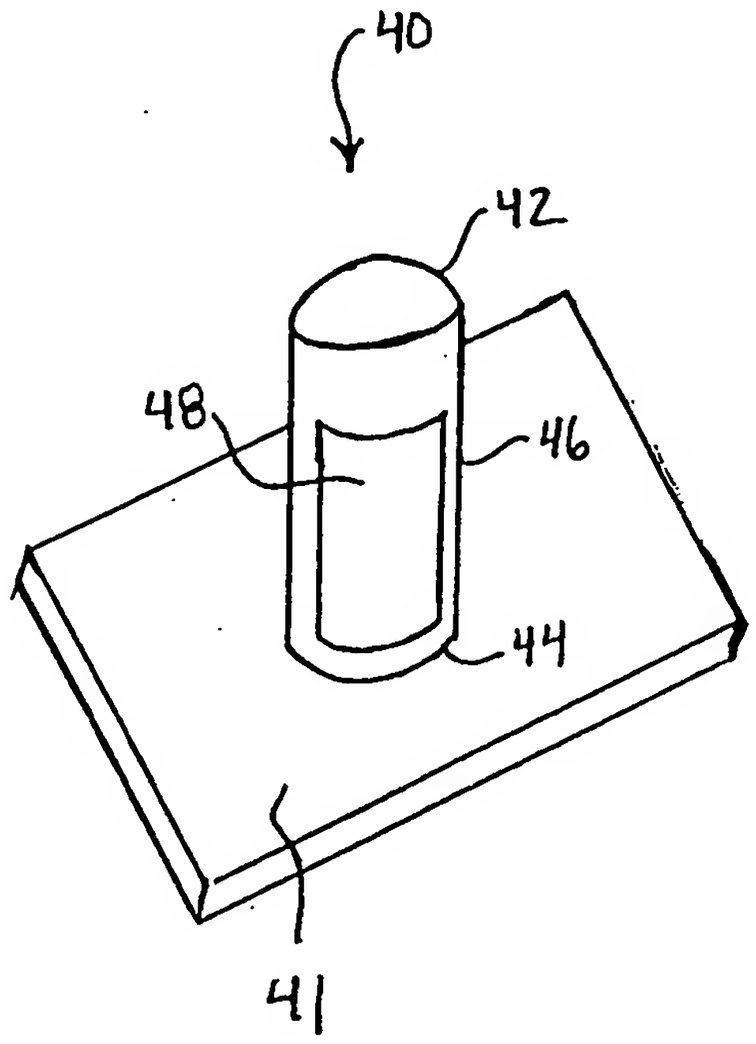

Fig. 6

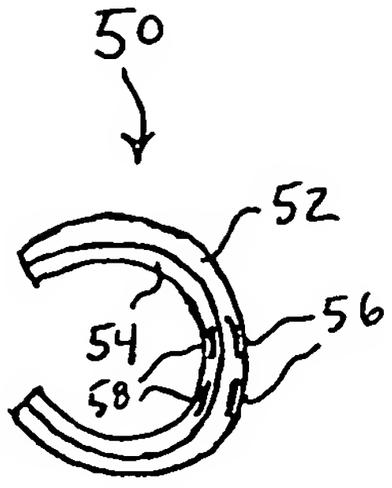

Fig. 7

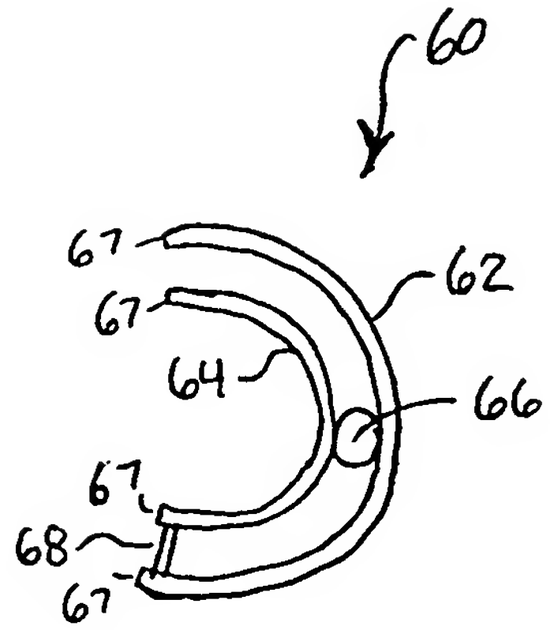

Fig. 8

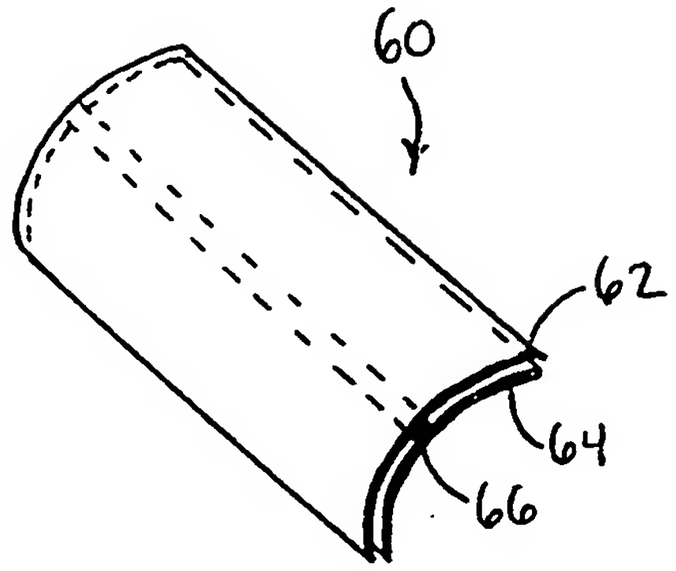

Fig. 9

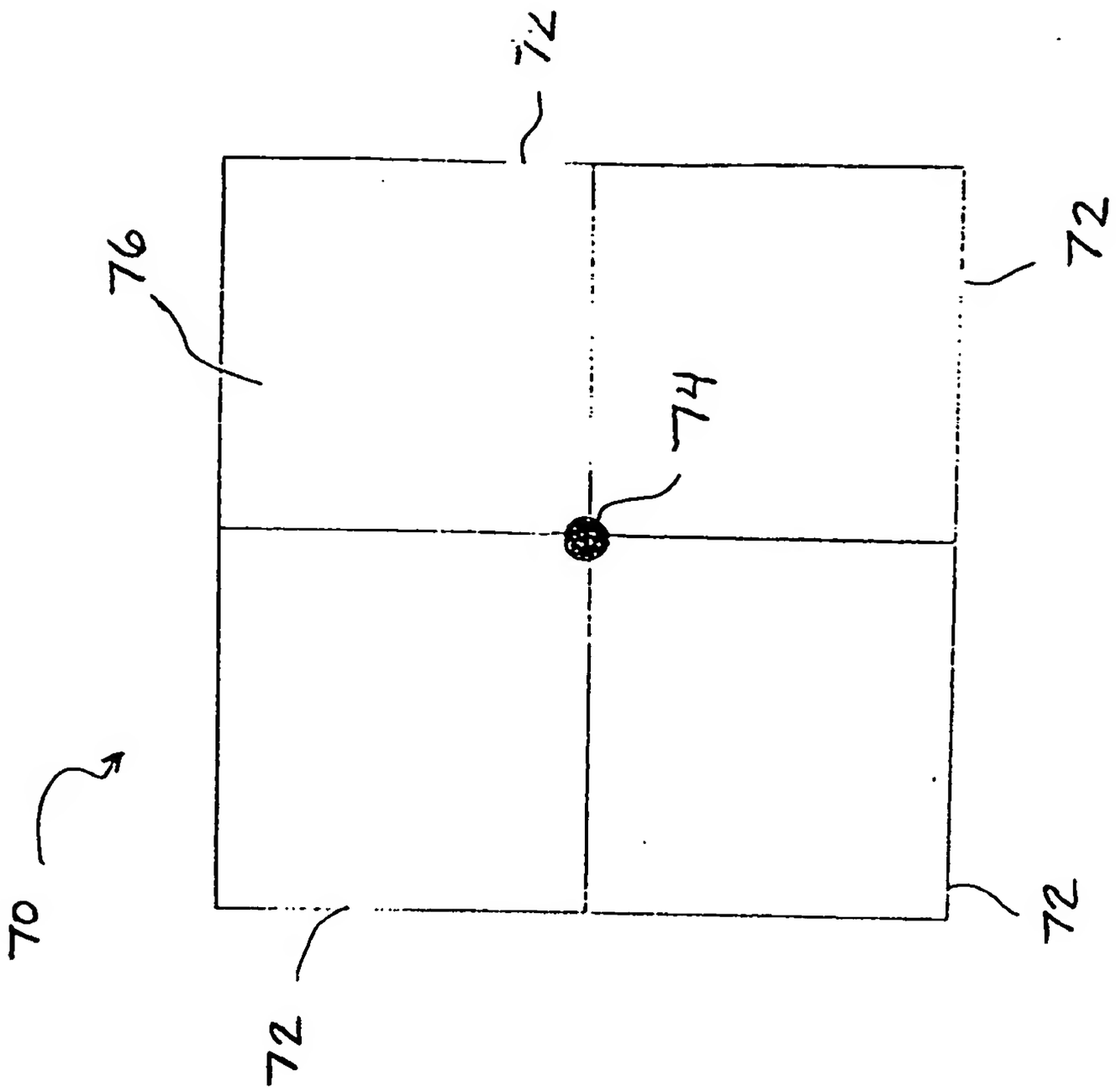

FIG. 11

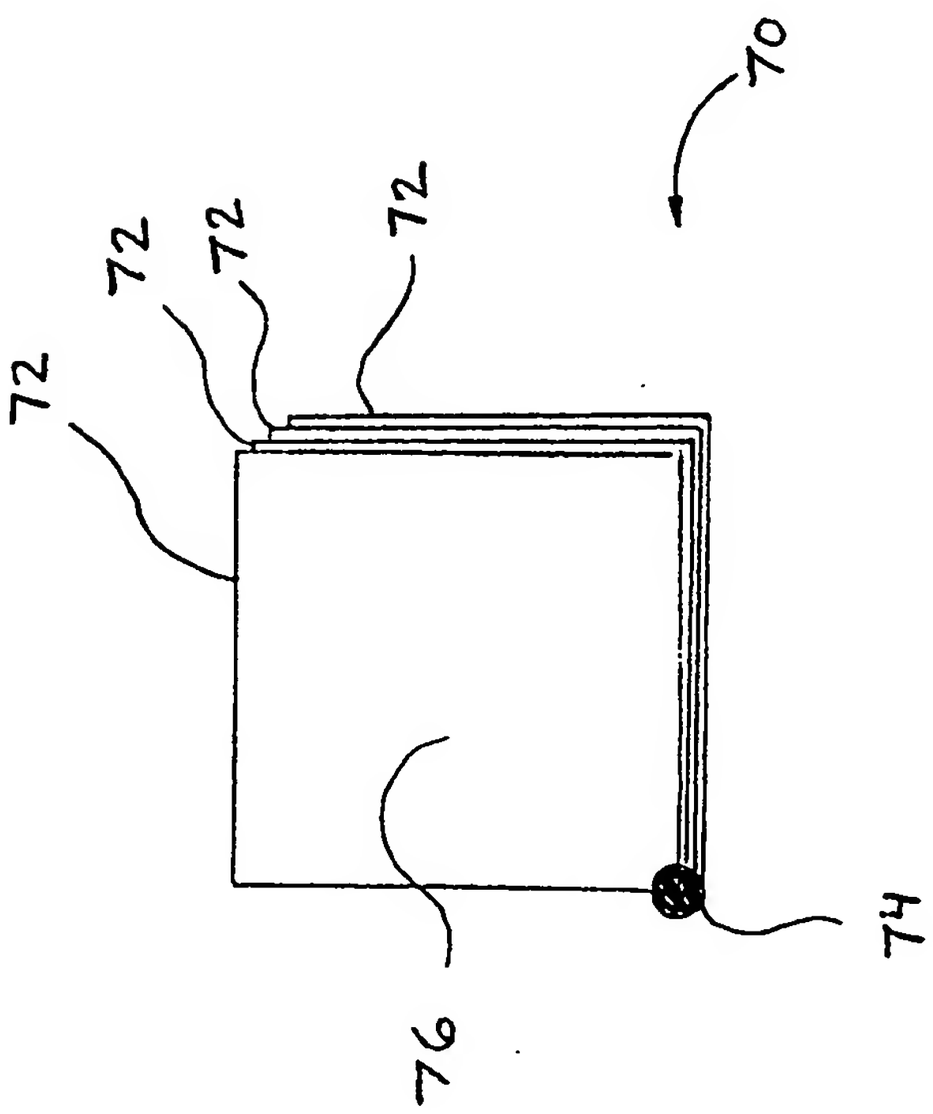

FIG. 10

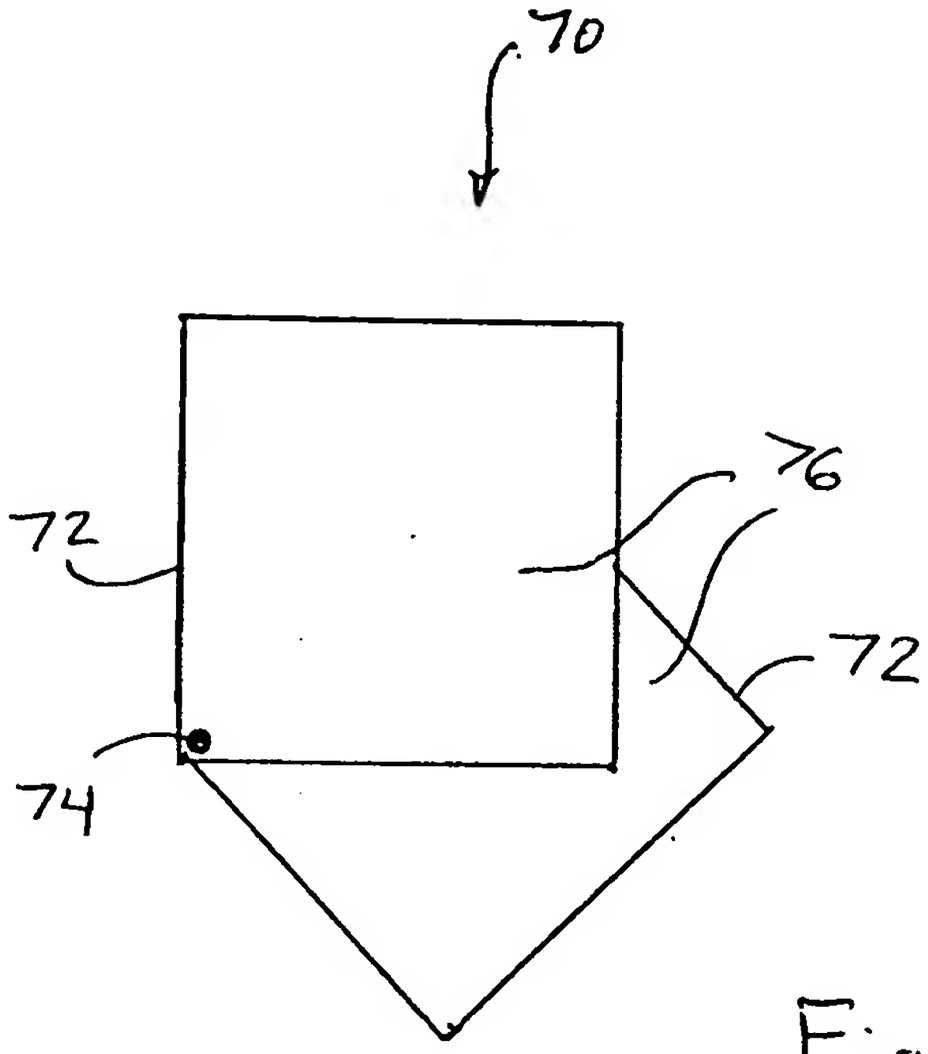

Fig. 12

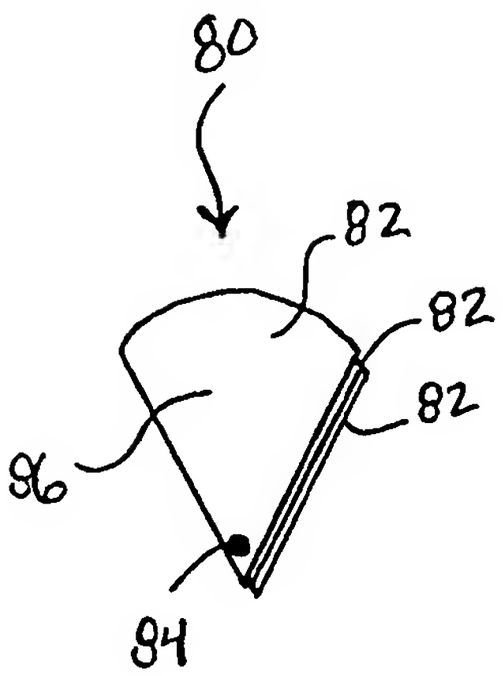

Fig. 13

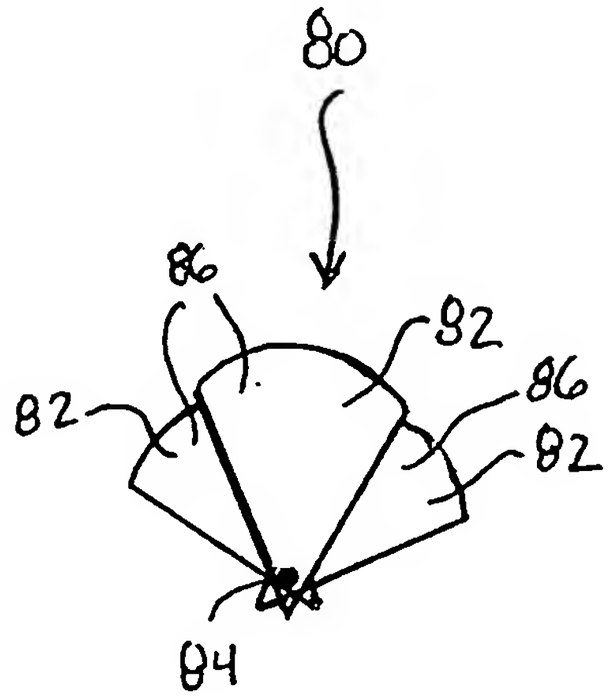

Fig. 14

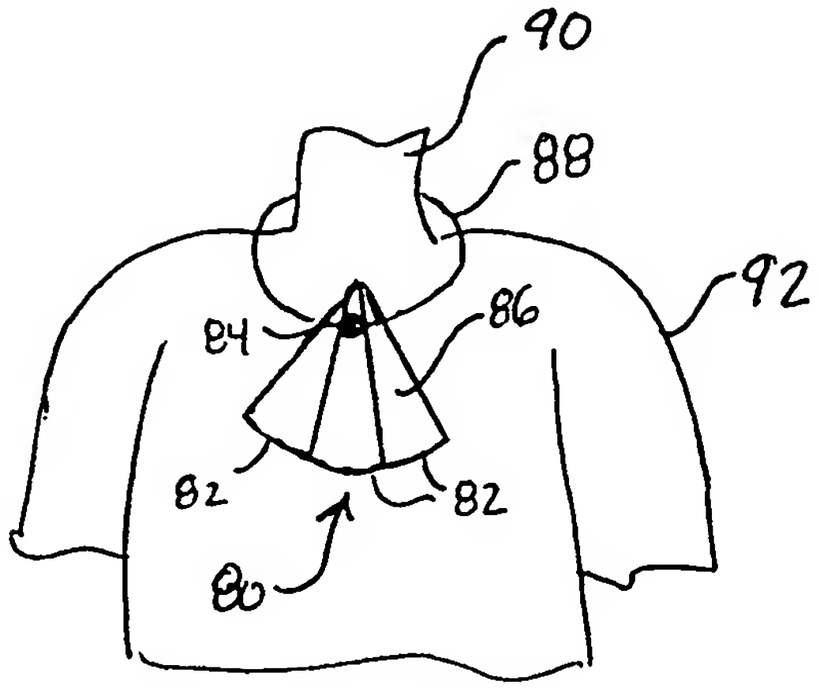

Fig. 15

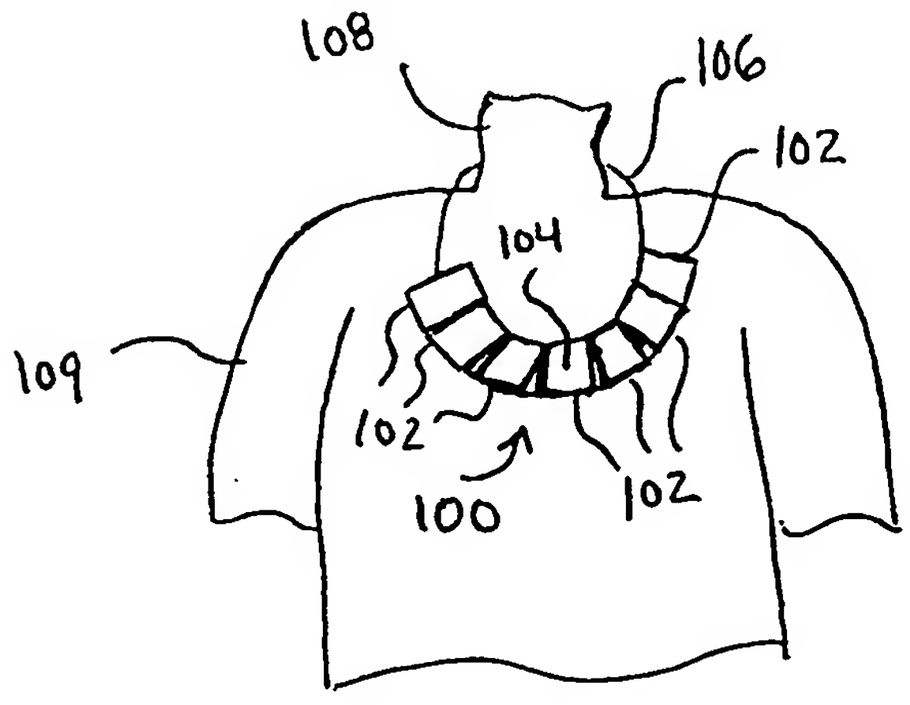

Fig. 16

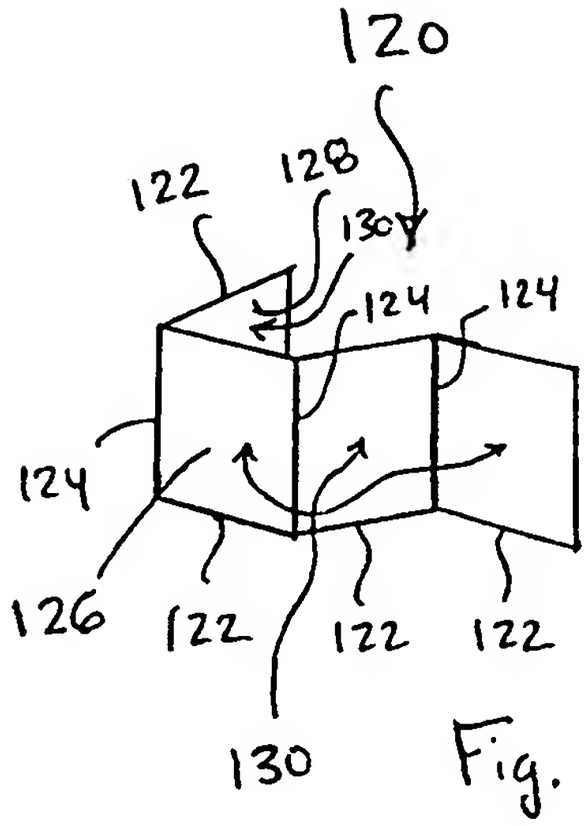

Fig. 17

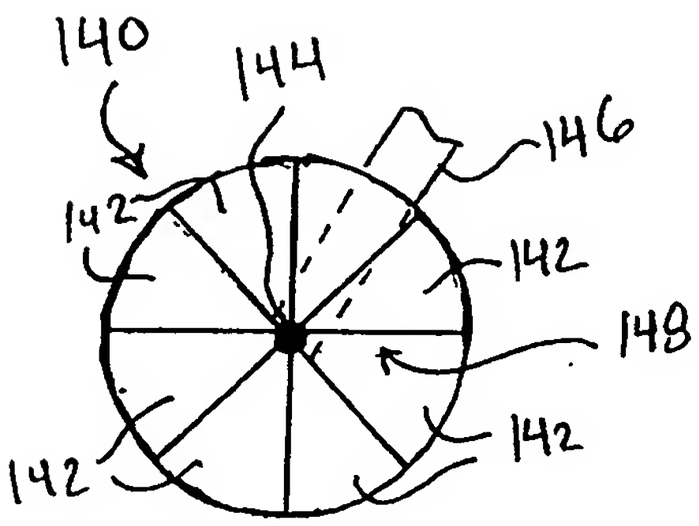

Fig. 18

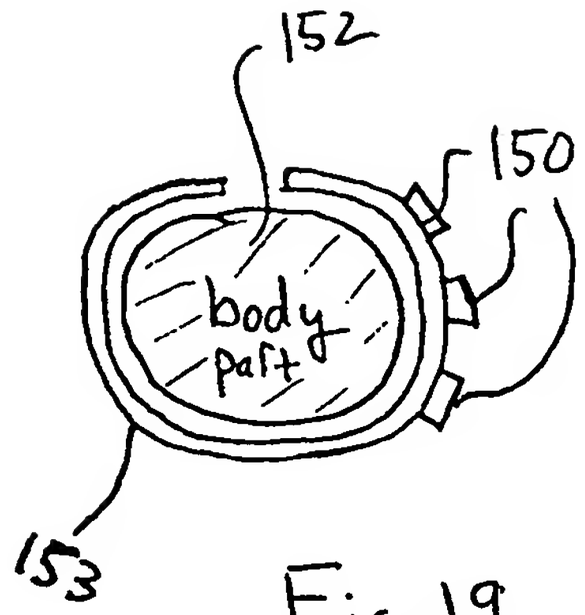

Fig. 19

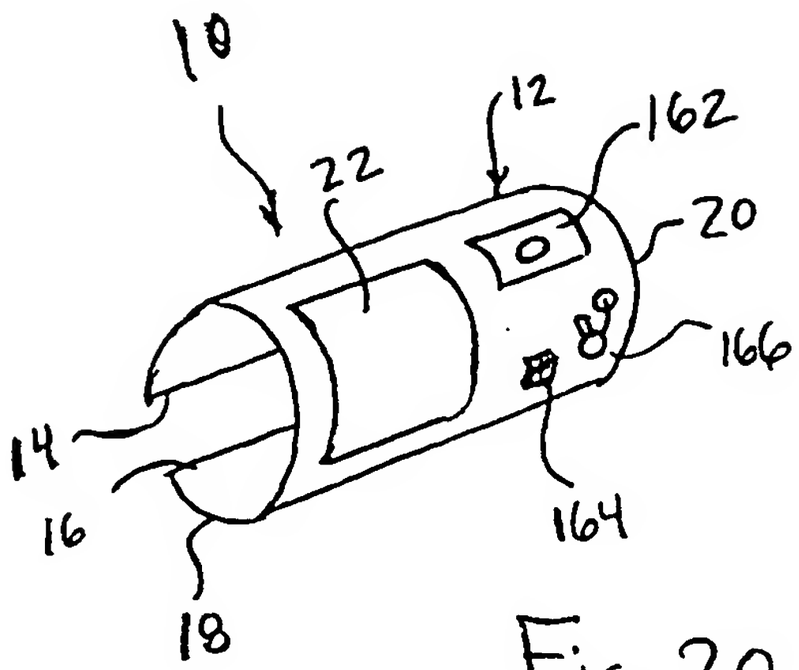

Fig. 20

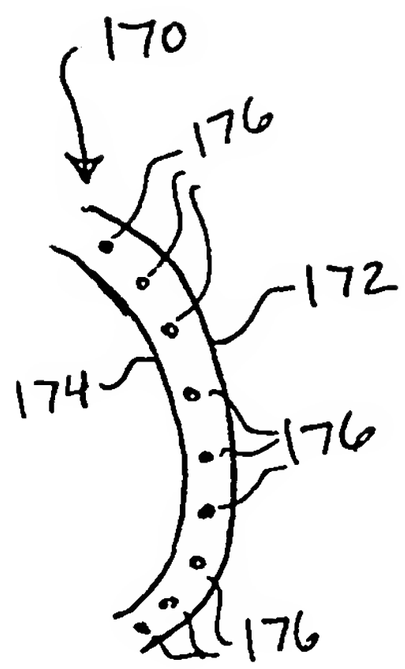

Fig. 21

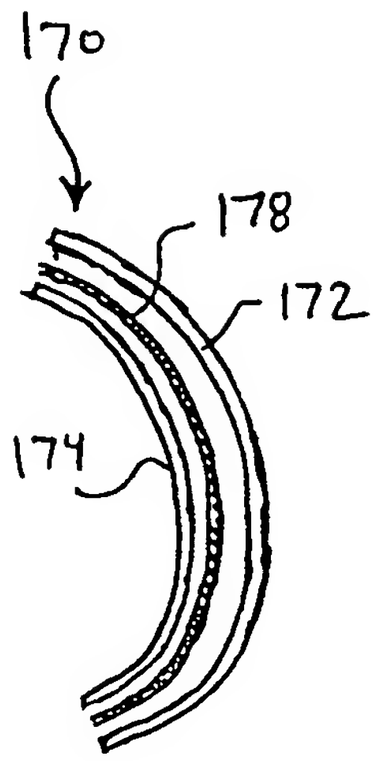

Fig. 22